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# Marine Turtle Nest Translocation Due to Hurricane Threat on Réunion Island

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Although Réunion Island was an important nesting site for marine turtles before human colonisation (Dubois1669 in Lougnon 1992), nesting activity has significantly decreased toward the end of the 20th century. Between 1986 and 2003 only four observations of marine turtle nesting activities have been recorded. More recently, nesting activity has increased but the total number remains low. From June 2004 to October 2005, eight nests were recorded on one beach at Saint Leu (Ciccione & Bourjea 2006). Between January and September 2007, six nests were observed: one was the first recorded on Cap Lahoussaye, and the other five were laid on St Leu beach, similar to nests laid in 2004 and 2005. Nest monitoring has become an essential component in the conservation of the green turtle population of Réunion Island.

On 27 January 2007, four tracks and one nest of green turtle were sighted on Cap Lahoussaye beach. The beach is narrow, and the female laid against a retaining wall next to a road running along the beach (Fig. 1). On 3 March 2007, a hurricane was forecast to pass near Réunion Island and cause a heavy swell that would have threatened the nest. An administrative authorization was given to translocate a part of the eggs to the artificial beach of the Kelonia, the marine turtle observatory. From the nest, 65 eggs were translocated and 30 eggs were left in the original location as a control. Egg incubation had reached 35 days at the time of relocation, hence it was important to maintain the axial orientation of each egg to avoid killing the embryos (Limpus *et al* 1979). To facilitate this, a cross was drawn on the top of each egg with a pencil before it was removed carefully from the nest. To protect the eggs from temperature shock during the transport, they were deposited on a sand bed, and then covered with a piece of linen and sand. In Kelonia, a 60 cm deep and cylindrical artificial nest was excavated, into which the eggs were placed delicately and then covered by the sand coming from the original beach. The weather degraded through the operation as

**Figure 1.** The nesting crawl and nest location of a green turtle on Réunion Island. Lower panel shows amount of sand lost after a tropical cyclone passed the island.

| Nest | Date laid | Incubation period | Eggs | Live hatchlings | Hatching success | Dead hatchlings | Embryonic death | Undeveloped eggs |
|---|---|---|---|---|---|---|---|---|
| 1 (control) | 28/01/07 | / | 30 | 0 | 0 | | | |
| 1 (relocated) | | 51 d | 65 | 40 | 61.5 | 0 | 16 | 9 |
| 2 | 1/6/2007 | 87 d | 93 | 61 | 65.59 | 10 | 17 | 5 |
| 3 | 16/06/07 | 116 d | 133 | 38 | 28.57 | 7 | 70 | 18 |
| 4 | 2/7/2007 | 106 d | 135 | 71 | 52.59 | 11 | 23 | 30 |
| 5 | 19/07/07 | 98 d | 81 | 72 | 88.89 | 0 | 8 | 1 |
| 6 | 8/8/2007 | 90 d | 60 | 44 | 73.33 | 6 | 7 | 3 |

**Table 1.** Monitoring of green turtle (Chelonia mydas) translocated nest coming from Cap Lahoussaye beach (nest 1), and *in situ* nests from one Saint Leu beach (nest 2 to 6), Réunion Island. Nests 2 to 6 were laid by the same female.

the cyclone approached the coast. By the time the excavation was completed, rain began to fall.

The 30 eggs left in the original nest were washed away by the hurricane-induced waves. From the translocated eggs, 40 hatchlings emerged 20 March 2007 (Table 1), and were released on the adjacent beach where nesting activity has regularly occurred since 2004. Post-emergence nest exhumation showed 9 undeveloped eggs (no obvious embryo) and 16 eggs with larger dead embryos at different development stages (Table 1). These eggs were located at the periphery of the nest.

Between the 01 June and 08 August 2007, 13 tracks were recorded on one beach of St Leu. The monitoring put in place by Kelonia's staff suggested that the tracks were left by the same female, and she laid five nests during this period. Each nest were located by the staff and left *in situ*, with no sign to indicate their position to beachgoers. Because of the exceptional nature of nesting activities on the island, there was a concern that any sign would attract too much curiosity and have a negative impact on the eggs and hatchlings. Regular monitoring allowed the staff to assist with full or partial hatchlings emergence events. 40 hatchings from translocated nest and 216 hatchlings from 5 nests were measured and released to the ocean (Table 2).

Delayed translocation may not be the main factor influencing on hatchling success as it was shown in Abella (2007). The survival rate observed for the translocated eggs (61.5%) is close to the mean survival rate (57.0% (range: 28.6 - 88.9%) observed for the other 5 *in situ* nests laid in 2007 in St Leu. One of these nests had a low survival rate (28.6%), likely due to its location under a tree on the beach that is also used by beachgoers during the day; inadvertent trampling was likely the main contributor to the reduced hatchling production of this nest. In the translocated nest, the mortality observed may have been caused by temperature variation between the original and the artificial nest due to weather degradation during artificial nest excavation. The translocation process took longer than expected (ca. 1hr), as the beach is located 30 minutes drive from Kelonia) and also because of the extra care taken during eggs removal and transport. Sand temperature is essential for the embryonic development of sea turtles eggs, not only for the embryo survival but also for the sex ratio (Mrosovsky 1982). Egg translocation has been shown to be effective in conservation of different sea turtles species (Dutton *et al.* 2005; Kornaraki *et al.* 2006) but it is a tool that should be used with a great care because of the possible impact on sex ratio output that can influence long-term population dynamics (Mrosovsky & Yntema 1980). In this particular case, the precautions taken during translocation allowed saving one of the rare nests laid in Réunion Island. In terms of sex ratio, we did not measure nest temperatures, but the information on incubation duration may be informative, given the relationship between incubation duration and sex ratio in green turtle nests (Godley et al. 2002). From the data on incubation duration (Table 1), there is a high probability that the translocated nest laid in January 2007 produced more females than the five other nests laid during a cooler period between June and August 2007.

| Nest #, Location | Average mass (g) | Average SCL (cm) |
|---|---|---|
| Cap Lahoussaye (n=40 translocated) | 25.8 ± 1.5 | 4.97 ± 0.16 |
| 1, St Leu (n=27) | 23.2 ± 1.32 | 5.04 ± 0.15 |
| 2, St Leu (n=55) | 24.2 ± 1.18 | 4.94 ± 0.14 |
| 3, St Leu (n=77) | 24.0 ± 1.32 | 4.96 ± 0.20 |
| 4, St Leu (n=7) | 25.6 ± 1.41 | 4.95 ± 0.10 |
| 5, St Leu (n=50) | 21.64 ± 1.35 | 4.77 ± 0.16 |

**Table 2.** Mass and straight carapace length (SCL) recorded from hatchlings green turtle nests on the west coast of Réunion Island. n = number of hatchlings measured. Means given ± SD.


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# Loggerhead Sea Turtles (Caretta caretta) in Marine Waters off Ecuador: Occurrence, Distribution and Bycatch from the Eastern Pacific Ocean

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Loggerheads are globally distributed mainly in temperate, tropical and subtropical marine regions, inhabiting both oceanic and neritic waters (Carr 1952; Dodd 1988; NMFS & USFWS 1998a; Bolten 2003). This species has been also considered as an exception in geographical distribution of sea turtles since this species is not as abundant as other species in tropical areas or for having an antitropical or more temperate distribution (Pritchard 1997; Bowen 2003; Pritchard 2003). Breeding distribution for this species in the Pacific Ocean is restricted to Japan and to eastern Australia and southern New Caledonia (NMFS & USFWS 1998a; Limpus & Limpus 2003). In the Eastern Pacific Ocean, the loggerhead's in-water distribution ranges from Alaska, North America, to Chile, South America (Carr 1952; Frazier 1981; Marquez 1990; NMFS & USFWS 1998a). Recently, this species has been shown to occur in costal zones (carapaces of animals) and marine waters off Peru (turtles captured by artisanal fisheries from Vilo Vilo, Illo and Morro Sama fishing human communities) between latitudes 12–20°S and longitudes 80–70°W (Kelez *et al.* 2003 Alfaro–Shigueto *et al.* 2004). The confirmed occurrence of most of these observations (n = 25 individuals) has been supported by both morphometric measurements and genetic analysis of mitochondrial DNA (mtDNA), suggesting that this species is more common in this area of Pacific than previously believed (Alfaro–Shigueto *et al.* 2004; Dutton *et al.* unpublished data). One hypothesis suggests that loggerheads found in the Eastern Pacific Ocean come from the western Pacific in view of the absence of nesting beaches on the coasts of the Eastern Pacific (NMFS & USFWS 1998a; Kelez *et al.* 2003). Moreover, the mtDNA study from three animals recorded in Peru supports the fact that these loggerheads are from Australian rookeries (Dutton *et al.* in Alfaro-Shigeto et al., 2004) Furthermore, loggerheads have been found to occur in marine waters off northern Chile through capture of individuals by longline fisheries (Donoso *et al.* 2000). On the other hand, there is a lack of documentation of this species in Central America and southern Colombia, and no loggerhead records from the coastal zone and marine waters off Ecuador have been documented (Frazier *et al.* 1981; Cornelius 1982; Green & Ortiz 1982; Alava 2000a). Even though extensive and intensive monitoring along the Ecuadorian beaches have been undertaken in the last decade, no stranded animals, carcasses or carapaces have been found, excluding it from the sea turtles species listed for this country (Alava 2000a; Alava *et al.* 2005). Likewise, while fishery interactions for this species have recently been documented in Peru and Chile (Donoso *et al.* 2000; Alfaro–Shigueto *et al.* 2004), the status of knowledge on loggerhead bycatch is unknown in the Ecuadorian marine territory, with no records on artisanal fishery landings for this particular species (Hurtado 1987; Alava 2000b). This article presents a review on data mainly collected by the Inter American Tropical Tuna Commission (IATTC) regarding extent of occurrence and fishery interactions in marine water off Ecuador and in other areas of the Eastern Pacific Ocean during the period 1993–2002. Furthermore, I focus on the loggerhead distribution by proposing and testing hypotheses of why turtles are distributed as they are off Ecuador.

Data were available online (http://www.iattc.org) from two IATTC unpublished reports: documents BYC–4–04 and BIC–4–05a (IATTC 2004a; IATTC 2004b) that were produced from the 4th Meeting of the IATTC–Working Group on Bycatch (4-16 January, 2004, Kobe,

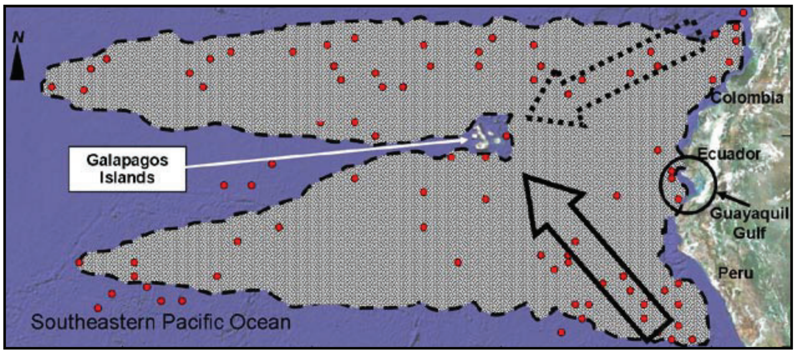


**Figure 1.** Abundance and distribution of olive ridley (large dotted area with dashed boundaries) and loggerhead turtles (scattered red dots) in marine waters off Ecuador. The figure shows the overlapping of distribution areas for both turtles mainly at the southward and northward areas, with olive ridley being the most abundant compared to the sightings of loggerhead. Arrow with solid line depicts the Humboldt Current and arrow with the dotted line depicts the Panama or El Nino Current. Data adapted from Figures 2a and 2b in IATTC 2004a.